

What we claim is:

1. An electric power unit for driving a display unit having: a first voltage conversion circuit for stepping up an inputted power supply voltage to generate a first output power supply voltage; a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a group of high output voltages (high output voltage group) that are lower than said first output power supply voltage in the order mentioned; and a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a group of low output voltage (low output voltage group), said electric power unit comprising:

a second voltage conversion circuit for stepping down the highest output voltage of said high output voltage group to generate a second output power supply voltage that is lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of said low output voltage group; and

a third voltage conversion circuit for stepping up said inputted power supply voltage to generate a third output power supply voltage that is lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of said low output voltage group, wherein

said first through third output power supply voltages are provided as the operating voltages of said buffers associated with said high output voltage group and low output voltage group.

2. The electric power unit according to claim 1, wherein

said buffer circuit outputting the highest output voltage of said high output voltage group is energized by the first output power supply voltage;

at least one of other said buffer circuits associated with said high output voltage group is energized by said first output power supply voltage or said first output voltage, and by said second output power supply voltage; and

at least one of said buffer circuits associated with said low output voltage group is energized by said third output power supply voltage and a reference voltage.

3. The electric power unit for driving a display unit, comprising:

a first voltage conversion circuit for stepping up an inputted power supply voltage to generate a first output power supply voltage;

a second voltage conversion circuit for stepping down said first output power supply voltage to generate a second output power supply voltage;

a third voltage conversion circuit for stepping up said inputted power supply voltage to generate a third output power supply voltage lower than said second output power supply voltage; and

a multiplicity of buffer circuits for respectively generating output voltages from said first through third output power supply voltages.

4. The electric power unit according to claim 3, wherein

a first buffer circuit outputting the highest output voltage of said output voltages is energized by said first output supply voltage;

at least one of second buffer circuits respectively outputting intermediate output voltages of said multiple output voltages is energized by

said first output power supply voltage or said highest output voltage and by said second output power supply voltage; and

a third buffer circuit outputting the lowest output voltage of said multiple output voltages is energized by said third output power supply voltage and a reference voltage.

5. An electric power unit for driving a display unit, comprising:

a first voltage conversion circuit for stepping up an inputted power supply voltage to generate a first output power supply voltage;

a reference voltage generating circuit that generates a first reference voltage, a second reference voltage, a third reference voltage, a fourth reference voltage, a fifth reference voltage, and a sixth voltage based on said first output power supply voltage, all lower than said first output power supply voltage in the order mentioned;

a first buffer circuit receiving said first reference voltage to generate a first output voltage;

a second buffer circuit receiving said second reference voltage to generate a second output voltage;

a third buffer circuit receiving said third reference voltage to generate a third output voltage;

a fourth buffer circuit receiving said fourth reference voltage to generate a fourth output voltage;

a fifth buffer circuit receiving said fifth reference voltage to generate a fifth output voltage;

a second voltage conversion circuit receiving said first output voltage and stepping down said first output voltage to generate a second output

power supply voltage lower than said third output voltage but higher than said fourth output voltage; and

a third voltage conversion circuit for stepping up said inputted power supply voltage to generate a third output power supply voltage lower than said third output voltage but higher than said fourth output voltage, wherein

said first buffer circuit is energized by said first output power supply voltage, and

said second buffer circuit is energized by said first output power supply voltage or first output voltage and by said second output power supply voltage;

said third buffer circuit is energized by said second output power supply voltage;

said fourth buffer circuit is energized by said third output power supply voltage; and

said fifth buffer circuit is energized by said third output power supply voltage and said sixth voltage.

6. The electric power unit according to claim 5, wherein

said second voltage conversion circuit is a charge pump-type step-down circuit, while said first voltage conversion circuit and said third voltage conversion circuit are charge pump-type step-up circuits; and

said second output power supply voltage is higher than said third output power supply voltage.

7. The electric power unit according to claim 6, wherein

said first buffer circuit is provided with

a first MOS transistor between nodes of said first output power supply voltage and said first output voltage, and

a first operational amplifier receiving said first reference voltage and first output voltage to generate a control signal to said first MOS transistor;

said second buffer circuit is provided with

a second MOS transistor and a third transistor connected in series between nodes of said first output power supply voltage or first output voltage and said second output power supply voltage, and providing at the node of said second and third MOS transistors said second output voltage,

a second operational amplifier receiving said second reference voltage and second output voltage and outputting a control signal to said second MOS transistor, and

a third operational amplifier receiving said second reference voltage and second output voltage, and outputting a control signal to said third MOS transistor;

said third buffer circuit is provided with

a fourth MOS transistor connected between nodes of said third output voltage and second output power supply voltage, and

a fourth operational amplifier receiving said third reference voltage and third output voltage and outputting a control signal to said fourth MOS transistor;

said fourth buffer circuit is provided with

a fifth MOS transistor connected between nodes of said third output power supply voltage and fourth output voltage, and

a fifth operational amplifier receiving said fourth reference voltage and fourth output voltage and outputting a control signal to said fifth MOS transistor,

said fifth buffer circuit is provided with

a sixth MOS transistor and a seventh transistor connected in series between nodes of said third output power supply voltage and sixth voltage and outputting at the node of said MOS transistors and said fifth output voltage,

a sixth operational amplifier receiving said fifth reference voltage and fifth output voltage and outputting a control signal to said sixth MOS transistor, and

a seventh operational amplifier receiving said fifth reference voltage and fifth output voltage and outputting a control signal to said seventh MOS transistor .

8. The electric power unit for driving a display unit, having:

a multiplicity of buffer circuits for generating, based on a first output power supply voltage higher than an inputted power supply voltage, a group of high output voltages (high output voltage group) that are lower than said first output power supply voltage, and

a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a group of low output voltages (low output voltage group) in the order mentioned;

said electric power unit comprising:

a first voltage conversion circuit for generating said first output power supply voltage;

a second voltage conversion circuit for stepping up the inputted power supply voltage to generate a controlled constant second output power supply voltage lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of said low output voltage group; and

a third voltage conversion circuit for stepping up said inputted power supply voltage to generate a third output power supply voltage that is lower than the lowest output voltage of the high output voltage group but higher than the highest output voltage of the low output voltage group, wherein

said first voltage conversion circuit steps up said second output power supply voltage to generate said first output power supply voltage; and

said first through third output power supply voltage are provided as the operating voltages of said buffer circuits associated with said high output voltage group and low output voltage group.

9. The electric power unit according to claim 8, wherein

said buffer circuit outputting the highest output voltage of said high output voltage group is energized by said first output power supply voltage;

at least one of other said buffer circuits associated with said high output voltage group is energized by said first output power supply voltage or said first output voltage and by said second output power supply voltage; and

at least one of said buffer circuits associated with said low voltage group is energized by said third output power supply voltage and a reference voltage.

10. An electric power unit for driving a display unit, comprising:

a first voltage conversion circuit for generating a first output power supply voltage higher than an inputted power supply voltage;

a second voltage conversion circuit for generating a second output power supply voltage lower than said first output power supply voltage;

a third voltage conversion circuit for generating a third output power supply voltage lower than said second output power supply voltage; and

a multiplicity of buffer circuits receiving said first through third output supply voltages and generating therefrom a multiplicity of different output voltages, wherein

said second voltage conversion circuit steps up an inputted power supply voltage to generate said second output power supply voltage having a controlled constant voltage,

said first voltage conversion circuit receives and steps up said second output power supply voltage to output said first output power supply voltage; and

said third voltage conversion circuit steps up said inputted power supply voltage to generate said third output power supply voltage.

11. The electric power unit according to claim 10, wherein

a first buffer circuit for outputting the highest output voltage of said output voltages is energized by said first output power supply voltage;

at least one of said second buffer circuits for respectively outputting intermediate output voltages of said output voltages is energized by said first output power supply voltage or the highest output voltage and by said second output power supply voltage; and

a third buffer circuit for outputting said lowest output voltage of said output voltages is energized by said third output power supply voltage and a reference voltage.

12. The electric power unit according to claim 11, wherein

said second voltage conversion circuit provides a feedback voltage in accord with the highest output voltage of said buffer circuit to control said second output power supply voltage such that said feedback voltage remains constant.

13. The electric power unit according to claim 11, wherein

said second voltage conversion circuit provides a feedback voltage in accord with said second output power supply voltage to control said second output power supply voltage such that said feedback voltage remains constant.

14. The electric power unit according to claim 12, wherein

each of said first, second, and third voltage conversion circuits is a charge pump-type voltage conversion circuit adapted to step up a voltage in units of inputted power supply voltage.

15. The electric power unit according to claim 14, wherein

said second voltage conversion circuit includes a clock generator for generating a multiplicity of clocks for timing charge pump operation of said second voltage conversion circuit, and a comparator for comparing said

feedback voltage with a reference voltage to generate an output indicative of said comparison (comparison output), and wherein

said clock generator is enabled and disabled by said comparison output.

16. An electric power unit for driving a display unit having:

a first voltage conversion circuit for generating a first output power supply voltage higher than an inputted power supply voltage;

a reference voltage generating circuit that generates a first reference voltage, a second reference voltage, a third reference voltage, a fourth reference voltage, a fifth reference voltage, and a sixth voltage based on said first output power supply voltage, all lower than said first output power supply voltage in the order mentioned;

a first buffer circuit receiving said first reference voltage to generate a first output voltage;

a second buffer circuit receiving said second reference voltage to generate a second output voltage;

a third buffer circuit receiving said third reference voltage to generate a third output voltage;

a fourth buffer circuit receiving said fourth reference voltage to generate a fourth output voltage; and

a fifth buffer circuit receiving said fifth reference voltage to generate a fifth output voltage, said electric power unit comprising:

a second voltage conversion circuit for stepping up said inputted power supply voltage to a constant second output voltage lower than said third output voltage but higher than said fourth output voltage; and

a third voltage conversion circuit for stepping up said inputted power supply voltage to a third output power supply voltage higher than said fourth output voltage but lower than said third output voltage, wherein

said first voltage conversion circuit receives said second output power supply voltage to output said first output power supply voltage by stepping up said second output power supply voltage in units of said inputted power supply voltage;

said first buffer circuit is energized by said first output power supply voltage;

said second buffer circuit is energized by said first output power supply voltage or first output voltage and by said second output power supply voltage;

said third buffer circuit is energized by said second output power supply voltage;

said fourth buffer circuit is energized by said third output power supply voltage;

said fifth buffer circuit is energized by said third output power supply voltage and said sixth voltage.

17. The electric power unit according to claim 16, wherein

said first buffer circuit is provided with

a first MOS transistor between nodes of said first output power supply voltage and said first output voltage, and

a first operational amplifier receiving said first reference voltage and first output voltage to output a control signal to said first MOS transistor;

said second buffer circuit is provided with
 a second MOS transistor and a third transistor connected in series between nodes of said first output power supply voltage or first output voltage and said second output power supply voltage, and providing at the node of said second and third MOS transistors said second output voltage,

 a second operational amplifier receiving said second reference voltage and second output voltage and outputting a control signal to said second MOS transistor, and

 a third operational amplifier receiving said second reference voltage and second output voltage and outputting a control signal to said third MOS transistor;

 said third buffer circuit is provided with

 a fourth MOS transistor connected between nodes of said third output voltage and second output power supply voltage, and

 a fourth operational amplifier receiving said third reference voltage and third output voltage and outputting a control signal to said fourth MOS transistor;

 said fourth buffer circuit is provided with

 a fifth MOS transistor connected between nodes of said third output power supply voltage and fourth output voltage, and

 a fifth operational amplifier receiving said fourth reference voltage and fourth output voltage and outputting a control signal to said fifth MOS transistor; and

 said fifth buffer circuit is provided with

 a sixth MOS transistor and a seventh transistor connected in series between nodes of said third output power supply voltage and sixth

voltage and outputting at the node of said MOS transistors and said fifth output voltage,

a sixth operational amplifier receiving said fifth reference voltage and fifth output voltage and outputting a control signal to said sixth MOS transistor, and

a seventh operational amplifier receiving said fifth reference voltage and fifth output voltage and outputting a control signal to said seventh MOS transistor.

18. A display unit, comprising:

a matrix-type display panel;

a common driver for providing a drive voltage to the common electrodes of said display panel;

a segment driver for providing a signal voltage to the segment electrodes of said display panel; and

an electric power unit for driving said common driver and segment driver, wherein

said electric power unit includes:

a first voltage conversion circuit for stepping up an inputted power supply voltage to generate a first output power supply voltage,

a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a group of high output voltages (high output voltage group), and

a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a group of low output voltages, each of

said high output voltages and low output voltages being lower than said first output power supply voltage in the order mentioned;

a second voltage conversion circuit for stepping down the highest output voltage of said high output voltage group to output a second output power supply voltage lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of said low output voltage group; and

a third voltage conversion circuit for stepping up said inputted power supply voltage to output a third output power supply voltage lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of side of said low output voltage group, wherein

said buffer circuit outputting the highest output voltage of said high output voltage group is energized by said first output power supply voltage;

at least one of other said buffer circuits associated with said high output voltage group is energized by said first output power supply voltage or first output voltage and by said second output power supply voltage; and

at least one of said buffer circuits associated with said low output voltage group is energized by said third output power supply voltage and reference voltage.

19. A display unit, comprising

a matrix-type display panel;

a common driver for providing a drive voltage to the common electrodes of said display panel;

a segment driver for providing a signal voltage to the segment electrodes of said display panel; and

an electric power unit for driving said common driver and segment driver, wherein

said electric power unit includes:

a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a first output power supply voltage higher than an inputted power supply voltage, a group of high output voltages (high output voltage group) and

a multiplicity of buffer circuits for generating, based on said first output power supply voltage, a group of low output voltages, each of said high output voltages and low output voltages being lower than said first output power supply voltage in the order mentioned;

a first voltage conversion circuit for generating said first output power supply voltage;

a second voltage conversion circuit for stepping up said inputted power supply voltage to generate a second constant output power supply voltage controlled to remain at a predetermined level, which is lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of said low output voltage group; and

a third voltage conversion circuit for stepping up said inputted power supply voltage to generate a third output power supply voltage lower than the lowest output voltage of said high output voltage group but higher than the highest output voltage of said low output voltage group, and wherein

said first voltage conversion circuit steps up said second output power supply voltage to output said first output power supply voltage;

said buffer circuit outputting the highest output voltage of said high output voltage group is energized by said first output power supply voltage;

 at least one of other said buffer circuits associated with said high output voltage group is energized by said first output power supply voltage or first output voltage and by said second output power supply voltage;

 at least one of said buffer circuits associated with said low output voltage group is energized by said third output power supply voltage and reference voltage.